

1. HHI User Pro, User's Guide

Thank you for purchasing the Halibut Electronics **HHI User Pro** adapter.



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3. Introduction

The HHI User Pro is an adapter that enables you to connect your headset to any radio that's compliant with the Open Headset Interconnect Standard (OHIS).

This User Guide will:

- Provide an overview of the HHI User Pro
- Explain how the HHI User Pro fits into a larger OHIS ecosystem.
- Explain how to configure the HHI User Pro for your headset.
- Help you troubleshoot any problems you might experience.
- Provide known configurations for some common headsets.
- Explain how to submit a new configuration to help the next person with your headset.

4. Document History

- 2023-05-25, v0.1: Initial draft.
- 2023-10-11, v1.0: Updated for production hardware.

5. About the HHI User Pro

The HHI User Pro is an adapter that enables you to connect your headset to any radio that's compliant with the Open Headset Interconnect Standard (OHIS). The HHI User Pro has a PTT button on the adapter, and provides a connector for an external PTT of your choice.

Note: For the purpose of this user guide, "headset" is defined as a single device or a collection of devices that include a PTT, microphone, and headphones or speaker. For example, it can be a literal headset, or a separate mic, speaker, and foot switch.

You can configure the HHI User Pro to work with nearly any headset, or microphone and speaker, etc. It includes three 3.5m TRRS connectors for:

- A microphone
- Headphones
- An external PTT (in addition to the built-in PTT)

Any signal can be routed to any pin using a jumper matrix, allowing for literally any pin-out on those connectors. HHI User Pro includes an optional pre-amp to allow for the use of either dynamic or electret microphones.

The HHI User Pro adapts your headsets's unique electrical and physical properties to an OHIS-compliant User Device socket, allowing it to connect to any OHIS-compliant radio.

5.1. About OHIS and HHI

OHIS is an open standard ("Free Like Speech") that defines the physical and electrical characteristics for the connections between a radio and headset. It does *not* specify the design or function of the devices themselves.

By working with OHIS-compliant radios and headsets (or radios and headsets connected to OHIS-compliant adapters), you can easily connect devices together and immediately start operating without needing to build or buy an adapter that's specific to the pairing of those two devices.

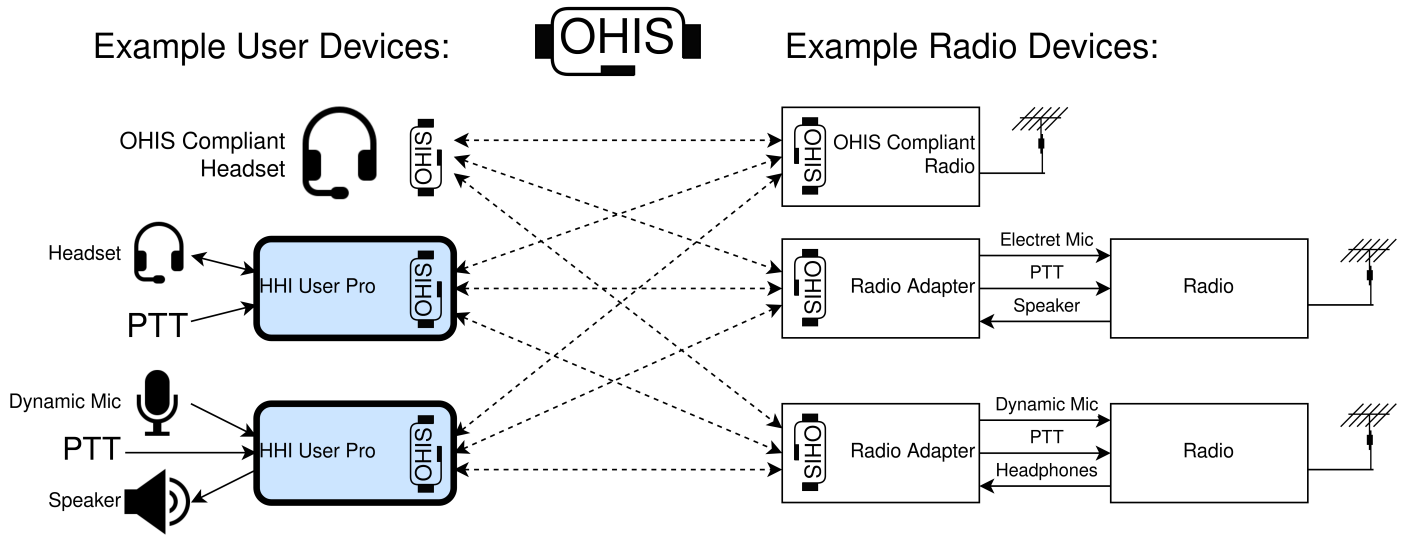
This is especially useful in a multi-user environment, such as a club shack, emergency operation center (EOC), or contest event like Field Day.

For more details on OHIS, see <https://ohis.org/>.

Halibut Electronics offers the Halibut Headset Interconnect (HHI) collection of products. All HHI products implement the OHIS standard in some way. For example, the HHI User Pro adapts headsets to the OHIS standard.

5.2. About Using the HHI User Pro in an OHIS-Compliant Environment

The following diagram illustrates how the HHI User Pro fits in an OHIS-compliant environment of multiple types of user devices (such as headsets or separate microphone and speaker) and radio devices:



The left side displays various user devices and the right side displays various radios devices.

All devices have different electrical and physical characteristics. Some support OHIS natively, and some require OHIS-compliant adapters. In this diagram, the non-compliant user devices use the HHI User Pro (this product) and the non-compliant radio devices use the HHI Radio Pro (a separate product) to become OHIS-compliant.

OHIS is the standard in the middle that enables any OHIS-compliant user device to connect to any OHIS-compliant radio device, regardless of any different underlying electrical and physical properties.

6. Getting Started

This section will walk you through tuning your HHI User Pro for use.

The high-level steps to get your Radio Pro operational are:

1. Verify your configuration is correct for your headset.
2. Adjust HHI User Pro mic level for your headset and voice.
3. Optionally disable the VU meter.

The tools required for this are:

- OHIS Radio Device (such as HHI Radio Pro) to provide power.
- Small flat-head "jewelers" screwdriver to adjust trim-pot.
- If you need to change the configuration, you'll also need:
 - PH1 Philips screwdriver for case screws.
 - Soldering iron and solder, to remove (but not save) surface mount resistors, and add solder blobs over jumper pads.

6.1. Verify Configuration

HHI User Pro comes pre-configured for one of many common headsets. However, all HHI User Pros can be re-configured to support any headset. If your headset is NOT supported by one of the pre-configured options, or if you are changing to a headset that requires a different configuration than what your HHI User Pro currently supports, then see the next section on [Configuring the HHI User Pro for your headset](#)

The rest of this section assumes your HHI User Pro is configured correctly for your headset, as is the case if you selected the correct headset when purchasing.

6.2. Adjust HHI User Pro Mic Level

The goal here is to adjust the gain of the User Pro so that the signal it sends out OHIS is in the standard range.

Note: The LEDs on the RJ-45 OHIS socket make a VU meter, or "volume meter," that shows the microphone audio level. The goal is to adjust the Mic Level trim pot until your normal speaking voice makes the green LED light up most of the time, and the yellow LED light up only occasionally. (On Early Access Program units, the VU meter LEDs were yellow and red, and were next to the trim pot instead of on the RJ-45.)

- Connect your headset or microphone to HHI User Pro.
- Connect HHI User Pro to an OHIS Radio Device (such as HHI Radio Pro) and connect that Radio Device to power.
 - We only need power from the OHIS Radio Device, it doesn't need to be configured or tuned. For example, the HHI Radio Pro User Guide tells you to adjust the User Pro (what you're doing right now) before you can do anything with the Radio Pro. That's ok.

- Talk into the microphone as you would normally while operating. Observe the "Mic Level" LEDs on RJ-45 OHIS port.
- Adjust the Mic Level trim pot (on the top surface of HHI User Pro) so that the green LED is lit most of the time, but the yellow LED barely blinks, or doesn't blink at all.

6.3. Optional: Disable VU Meter

The LEDs are what's called a VU (Volume Unit) meter. Once your HHI User Pro is properly adjusted, if the blinking LEDs bother you, they can be disabled without affecting anything else.

This is entirely optional.

- Remove the four #1 Philips screws, and remove the bottom of the plastic case.
 - Everything inside the case (not the case screws) is captured and won't fall off, though the end plates will rattle around a little bit.
- In the upper right corner is a surface mount jumper labeled "VU Meter Enable." Removing this SMT 0 ohm resistor (or solder blob, if you've already removed and replaced it) will turn off the VU meter and all its circuitry.
- If you wish to re-enable it later, you can place a solder-blob over the two pads to re-enable it.

6.4. Done!

All done! That was easy. You can now proceed to use this HHI User Pro while adjusting OHIS Radio Devices, such as the HHI Radio Pro.

7. Configure the HHI User Pro for your Headset

7.1. Pin Assignments

Your HHI User Pro was pre-configured for the headset you specified when ordering.

In case Halibut Electronics doesn't offer a pre-configured HHI User Pro for your headset, you'll have to configure it yourself. You can also modify a pre-configured HHI User Pro for a different headset. In either case, here's how the configuration works.

TODO Include a picture of the HHI User Pro, with the different sections labeled.

The HHI User Pro has a small matrix of jumpers to connect pins on physical connectors (rows), to logical signals (columns).

Note how there are two groups of four rows, that correspond to the Microphone and Headphone ports, labeled:

- "T" for Tip
- "R1" for Ring 1
- "R2" for Ring 2
- "S" for shield

Note: Only the Microphone and Headphone ports can be reconfigured. The PTT port is hardwired as a 2 pin connector: PTT on tip, Power Ground on Sleeve. The rings are not connected.

The columns correspond to signals:

- "Mic+", and "Mic-" for the microphone.
- "HP:L", "HP:R", and "HP:G" for headphones.
- "PTT", and "Gnd" for a PTT switch.
- "Shield" will connect a pin to the shield of the OHIS cable.

Note: Layout limitations required that the columns made a jog to the left between the two groups of four rows. The labels are angled to hopefully make it clear where the columns go.

The job of the configuration jumper field is to assign physical pins (rows) to logical signals (columns), by jumpering across the two. At the factory, this jumper is accomplished with a "0 Ohm Resistor" so it can be done by a surface mount pick-n-place machine. You can do it yourself with just a solder blob jumper between the two adjacent pads.

7.1.1. Grounds

Where possible, keep all grounds separate: Mic Ground, Headphone Ground, and Power Ground. This provides the best noise isolation.

However, this isn't always possible. For example, the CTIA headset standard shares a ground for Mic and Headphones. In these cases, it's acceptable to jumper multiple grounds to the same pin.

7.1.2. Shields

It's best to keep Ground and Shield isolated where possible. Only use the Shield if you know for sure that the shield is isolated from the ground in your headset cable.

The most common use for this is a 3.5mm TRS to XLR microphone cable: Tip is Mic+, Ring is Mic-, and Sleeve is Shield. RadioSport headsets also keep Mic- and Shield separate in their cables.

If you aren't sure, or if the return path/ground is not explicitly separate from shield (eg: headphones, left on tip, right on ring, ground/common on sleeve which is also the shield of the cable) then tie those to the relevant Grounds, and keep it separate from Shield. The rule is to keep return currents off the Shield signal. It's better to use Ground as a shield, than Shield as a ground.

7.2. Solder up the Configuration Jumper Field

The following assumes you have documentation for your headset, or whatever you are connecting to HHI User Pro. You will need to know which pins of the 3.5mm socket each signal should be on. You also need to know whether the microphone element is an Electret or Dynamic. (Carbon Equivalent microphones can be treated as Electret here. Condenser microphones that require phantom power will require an external phantom power injector.)

Let's apply the above pin-out information to the HHI User Pro configuration jumper field.

TODO Include picture of the HHI User Pro board, with sections labeled, for reference.

7.2.1. Microphone

Document which pins your headset uses:

- Mic+ Pin: _____
- Mic- Pin: _____
- PTT Pin: _____ (if appropriate)
- Shield Pin: _____ (if appropriate)
- Remove existing Microphone connector jumpers if they aren't where you want them.
- Add: Mic+
- Add: Mic-
- Add: PTT, if appropriate
- Add: Shield, if appropriate

7.2.2. Headphones

Document which pins your headset uses:

- Left Pin: _____
- Right Pin: _____
- Headphone Ground Pin: _____
- Mic+ Pin: _____ (if appropriate, eg: for CTIA headsets)
- Mic- Pin: _____ (if appropriate, eg: for CTIA headsets, same pin as Headphone Ground. Two signals on one pin.)
- PTT Pin: _____ (if appropriate)
- Shield Pin: _____ (if appropriate)
- Remove existing Headphone jumpers if they aren't where you want them.
- Add: Left
- Add: Right
- Add: Headphone Ground
- Add: Mic+, if appropriate
- Add: Mic-, if appropriate
- Add: PTT, if appropriate
- Add: Shield, if appropriate

7.2.3. Mic Preamp: Dynamic or Electret?

Note just above the upper left corner of the Microphone jumper field are three jumpers right next to each other, the two on the outside are oriented vertically and the one in the middle is horizontal. These three jumpers enable or disable (more accurately: bypass) the dynamic microphone preamp.

If your microphone is a **dynamic microphone**, then bridge the two vertical outer-most jumpers, and remove the horizontal center jumper.

TODO picture of jumpers for dynamic mic

If your microphone is an **electret microphone**, then remove the two vertical outer-mode jumpers, and bridge the horizontal center jumper.

TODO Picture of jumpers for electret mic

8. Troubleshooting

9. FAQ

9.1. "OHIS is Open. Does that mean Halibut Electronics products are Open Source Hardware?"

9.2. "What is the distinction between OHIS and HHI?"

9.3. "What kinds of headsets are supported by HHI User Pro?"

HHI User Pro is designed to work with as many headsets as possible, and can be used with external components to drive studio microphones and powered speakers. It will work with any audio device that meets the following specifications:

- Microphone:
 - Physical Connectors:
 - 3.5mm, aka 1/8 inch, "phone" connector, 4 pin TRRS. Also works with 2 pin TS, or 3 pin TRS.
 - Cables to convert 3.5mm TRS to other microphone connections, such as XLR, are commonly available.
 - Signal level, Electret: Between -15dBV and -48dBV.
 - Should also work with carbon equivalent elements.
 - Signal level, Dynamic: Between -30dBV and -63dBV
 - Impedance, Electret: Depends on Radio Device spec
 - Impedance, Dynamic: 10k ohm or less
 - Balanced, pseudo-balanced, or single-ended, depending on pin configuration.
 - DC Bias, Electret: Passed through from Radio Device.
 - DC Bias, Dynamic: Blocked.
- Headphones or Speaker:
 - Physical Connector:
 - 3.5mm 4 pin TRRS. Also works with 2 pin TS, or 3 pin TRS.
 - Signal level: Headphones, or Line Level.
 - Headphone power delivery depends on Radio Device spec.
 - Headphone and Line Level are about the same voltage (differing in impedance, therefore current), so the "Headphone" output can drive any speaker amplifier that takes a Line Level input.
- Push To Talk, PTT:
 - Physical Connector:
 - Dedicated 3.5mm TS. (Rings are not connected.)
 - Contact closure to ground.
 - HHI User Pro also has a built-in PTT button on the case.

9.4. "Grounds and Shielding: How do they even...?"

Entire books have been written on the subjects of grounding and shielding. There's no way to cover it all here. Instead, we will discuss what options HHI Radio Pro provides, what Halibut Electronics recommends, and let you choose how to handle your grounds and shields.

9.4.1. Ground vs Shield

OHIS, and therefore HHI Radio Pro, specifies separate return paths (ie: grounds) for a) Microphones, b) Headphones, and c) PTT/Power. In addition to the three separate return grounds, the shield is its own separate connection.

HHI Radio Pro ties the Shield to power ground on the OHIS side of the circuit, its own metal chassis, and copper shields on the circuit board with signal traces run on inner layers. None of the grounds from the radio are inherently connected to the shield, unless they are explicitly done so on the Config board.

Ideally, the various return grounds are treated as separate signals in their own right: the microphone being a balanced pair, headphones being two single ended signals with a shared reference and return ground, and the PTT just being a contact closure between two arbitrary pins. For example, an XLR microphone cable does this: separate pins for Mic+, Mic-, and Ground/Shield.

Unfortunately, this is not always possible. For example, most 3.5mm, 1/4", and RCA cables assume shield IS the return path/ground. A 3 pin TRS headphone connector puts Left audio on the tip, Right audio on the Ring, and the return ground on the Sleeve. The cable has two center conductors tied to Tip and Ring, and one shield tied to the Sleeve.

In this case, do you connect the Sleeve to the a) Headphone Ground, b) Shield, or c) both? If both, what is the impact of tying the headphone ground to the shield at that point in the circuit?

9.4.2. Ground Loops

Why not just connect all the grounds and shields together? It's all "ground", right?

Well, sort of. This is one possible philosophy: Connect everything together with as solid and direct a connection as possible, make your ground reference as low impedance as possible, and common to all uses of ground.

The problem here is, if you have multiple ground paths from Point A (eg: your radio) to Point B (eg: HHI Radio Pro), that creates a loop antenna, which will pick up stray magnetic fields and induce currents in your ground that are not the intentional result of return currents.

This can be mitigated by keeping the physical area of that loop as small as possible: Running the multiple ground paths physically near each other in a split-loom, for example. Also, shielding the multiple paths in a single shield, like a grounded conduit, will work similarly. When doing this, remember to consider *ALL* ground paths, including DC power, ground lug, USB cables to a computer, etc.

The other option is to minimize the number of loops in the ground, by making it a tree. Only connect the shields at one end of your cable, closest to the earth ground.

In the case of HHI Radio Pro, you have the option of connecting, or disconnecting, the shield of each connector to address this. Unfortunately, there's no way for Halibut Electronics to know your whole setup to know the best way to do this before shipping you a Config board.

10. Known Headset Configurations

10.1. Heil

10.2.1. Heil Dynamic

10.2.2. Heil Electret

10.2. RadioSport

10.3. CTIA

10.3.1. CTIA 4-pin TRRS

10.3.2. CTIA 2x 3-pin TRS

10.4. Studio Dynamic XLR